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INVESTIGATIONS OF CALIFORNIA OLIVES AND OLIVE OILS.

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By A. P. Hayne, Ph.B., Assistant in charge of Viticulture and Olive Culture.

The work done in the Olive Laboratory of the Agricultural Experiment Station of the University of California during the season of 1893–94 was on a larger scale than heretofore. The University Culture Stations were unable, owing to the youth of the trees, to furnish olives for experiment; but public-spirited growers from many parts of the State donated a sufficient quantity to enable the Central Station at Berkeley to make some valuable experiments in oil making and analysis. Sixty-seven samples of olives were received from ten of the leading olive-growing regions of the State. Ten of these samples were each large enough to be made into oil. The entire sixty-seven were analyzed by George E. Colby, Instructor and Chemist in the Viticultural Laboratory of the Station.

Before reporting upon the experiments, it is desirable to give some general data in regard to the various points involved.

MATURITY OF THE OLIVE.

It seems to be a common belief in California that the proper state of maturity of olives is when they have reached jet-blackness; also, that it makes little difference how long they remain on the tree, or in storage after being picked. This is an error, not only as regards the making of oil, but the pickling of the fruit also. The quantity of oil in the flesh is the same at the time of redness as it is a month after the jet-black color has been reached, so there is nothing to be gained in quantity by delaying the harvest. What is of more importance is that the *quality of the oil in the olives deteriorates the longer they are allowed to remain on the tree after proper maturity* (*redness*) *has been reached;* for the olein, which gives true quality to olive oil, diminishes; and the stearin, or solid "greasy" substance, increases. On the European market "greasy" oils bring lower prices than oils without this "greasy taste."

While it is true that some varieties naturally have more stearin than others, yet it is equally true that this "greasiness" is greatly lessened by early harvesting. In two lots of "Rubras" received at the University this year, one of a wine-red color, and the other jet black, this difference was noted at once, even by persons not accustomed to sampling oil. But aside from this "greasy" or "lardy" taste, oil made from over-ripe olives is more apt to "cloud," and to deposit a granular sediment in the bottles, than in the case of oil made from what are considered "underripe" olives. Should the temperature fall to 45°, the oil of the over-ripe olive will solidify, while that of the other will remain clear and brilliant till the temperature falls 8° or 10° lower. As a rule the purchaser will prefer a clear, brilliant oil to a solid one.

Right here it would be well to note that a popular idea seems to be that if an oil solidifies even at the freezing point of water, it is adulterated, while an oil remaining clear at the same temperature is pure. This is a misconception; for both pure olive oil, and the oils usually used for adulteration, solidify at about the same temperature; the difference generally being that partially clarified oil, or oil made from over-ripe olives, is the first to solidify or "freeze." It was found that olives picked in an "under-ripe" condition gave, almost without exception, an oil of a darker color; the jet-black olives gave oils much lighter or yellower in color; while the red olives almost invariably gave that beautiful olive-green tint that characterizes the highest grades of oil, due allowance being made for variety characteristics.

Another striking point brought out by the experimental work in the oil-room was that the same variety of olive grown in different localities yielded oils differing very strikingly in quality. Thus several lots of the so-called Redding Picholine were received, some of which were grown in deep rich bottom land, and others either on gravelly hillsides or on higher, well-drained, light soils. In every case the oil from the hillside olive was superior to that from the low lands. Oil from the rich soils was always harder to clarify, and prone to cloud up and solidify much sooner than that from poorer soils.

The Redding Picholine yields at best an oil of doubtful quality, but the difference in its oil, due to different classes of soil, was most strikingly illustrated. Not only was this noted in the case of the Redding Picholine, but also with Rubra, Oblonga, and varieties that give high grades of oil.

FROZEN OLIVES.

There are few parts of the olive-growing regions of the world where an exceptional season or an early frost does not sometimes surprise the grower before the harvest is completed. The fruit of the olive is much more sensitive to the effects of cold than the tree itself. Hence, in localities thus subject to early frosts, care should be taken to plant only those varieties that mature early, for once an olive has been frost-bitten, it is next to impossible to make a salable oil out of it, and it is quite impossible to make a pickle that can be eaten. The water in the juice of the olive freezes, and in so doing expands, tearing the tissue of the flesh. This of itself, of course, would not injure the quantity or quality of the oil in any way, but unless the frost-bitten berry is at once crushed and the oil expressed, the broken tissue decomposes and imparts to the oil a most disagreeable taste and odor, rendering it unfit for the table.

Among the samples of olives received at the Station this year were several that had been frost-bitten, either before picking or while awaiting shipment. These were separately made into oil as soon as possible. It was found that a delay of three days from the time the olives were frozen to the time of crushing and pressing, was fatal. The oil was, to the eye, as clear, and to all external appearances, as good as that made from unfrozen olives, but the taste was such as to render it unfit for use. The odor was very disagreeable and very pronounced, and those who tasted the oil pronounced it "made from fermented olives."

When we consider that a delay of three days in crushing caused this, we can at once realize the importance of early harvesting, and therefore, of the selection of early maturing varieties to escape frost, for on a large

scale it would practically be impossible to express the oil any sooner than three days.

This fact accentuates the importance also, of picking the fruit as soon as it reaches true maturity, instead of leaving it on the trees any longer than is absolutely necessary.

From the University Experiment Stations it was learned that the Nevadillo Blanco was the first to be frost-bitten, the Nigerina second, and the Pendulina third. This being an exceptionally severe season, it was found that at the four Stations where there were olive trees in bearing, all of the varieties were frozen before the first of January.

OIL-MAKING MACHINERY.

In 1892 the University imported from Saragossa, Spain, two newly-invented machines, said to be of great importance to the olive oil makers of California. One was a so-called "pitter," the other a "crusher" or "grinder." These, while certainly very ingenious, and accomplishing the object in view under certain circumstances, were found to be wholly unsuited to oil-making in California, or anywhere else where economy is an object.

It is generally conceded that the best oil is made from the first pressing of the pulp of the olive, *the pits being unbroken.* Practically, the oil of the second pressing does not differ materially in quality from the first, *always provided that no hot water is used;* it is therefore usually mixed with the first pressing. This is especially important in California, where we must make only oil of the very finest quality if we would hope to compete with the cotton-seed oil of the South and the cheap oils of Europe; it being generally conceded that the foreign countries can make inferior oil far cheaper than we can.

In testing these machines, then, these fundamental points must be kept in view; for it is not merely by the ease and rapidity of their work that they must be judged, but also by the relative quantity of oil yielded from the first and second pressings.

The Pitter and Crusher.

The so-called "pitter" does not remove the pits from the pulp, but merely tears the flesh, without breaking the pit. This is rather a good point, for it gives stiffness to the otherwise slippery mass. The machine itself consists of an endless screw in a metallic sleeve. The olive in passing down this screw is forced under a small wheel, which partially crushes it. Should the olive be of a variety having a large pit, the latter will be broken. If, however, the olive is small, it will pass underneath the crusher, and thus give little or no oil in the press. Under the most favorable circumstances, the yield of oil from this is far below that of the other machines. Hence, the Spanish "pitter" cannot be pronounced a success in this respect.

The second machine, the "crusher," consists of two iron cylinders, ribbed, and turning toward each other. It resembles a large sausage grinder, and is only useful in grinding up the dry residue from the first pressing, preparatory to the second pressing. While it certainly does reduce the residue to a finely divided state, it demands so much motive power that a good power engine is required. Even with sufficient

power it allows so little material to pass through at a time that it falls far short of the efficacy of the old "arrastra," or rolling millstones. Then, too, it is hard to clean, requiring the work of a good man for ten hours to get it in good condition. Besides all this, it is of untinned iron, which imparts to the oil an "inky" taste. This machine, therefore, proved practically a failure in our experiments.

Failing, then, to do good work with the Spanish machines, and having no time to build a regular "arrastra," a small fruit-juice press was obtained. This consists of an endless, tapering screw, inclosed in a conical sleeve. The olives, entering the grooves of the screw at the larger end, are gradually but gently mashed and twisted till the flesh is thoroughly crushed, without the pits being broken, by the time the olives escape at the smaller end of the machine. Though the apparatus used was but a foot long, it was found to do better work than either of the other two. It gave more oil from the first pressing, and while accomplishing the same result in quicker time, was easier to work. No doubt the same principle, on a larger scale, would give excellent results, and be cheaper and cleanlier than either of the others.

Oil Presses.

When the olives have been crushed they form a mass of pulp, pits, skins, oil, and water. In order to press the oil and water from this, it is necessary to put all into some form of envelope, porous enough to allow the liquid part to escape without pulp, pits, or skins. In Europe strong circular grass mats are used. These are filled with about 25 pounds of pulp, and placed one upon another under the flat "follower" that is attached to the lower end of the screw. When it is practicable to use these mats, any kind of oil press will serve. In California these mats cost from $1 50 to $2 apiece; hence are too expensive. Cloth has to be substituted for them, but the use of cloth, though more economical, necessitates presses specially adapted to this modification; for when the pulp has been divided into 25-pound packages, and wrapt in cloth, it is impossible to maintain the column in a vertical position, unless some kind of lateral support is used. This is done by the use of a cylindrical metallic, perforated sleeve that fits closely the column of pulp. But the sleeve cannot be used unless the flat steel "follower" at the lower end of the screw is of the same shape as the sleeve. Investigation has shown that many of the presses on the market are adapted only for the use of mats. That is, the flat piece of steel on the end of the screw occupies the entire space between the iron columns that support the screw, and there is no room for the sleeve. The press in use at the University is adapted for the use of either mats or cloth, having the "follower" at the end of the screw circular, and smaller than the sleeve. This was found to be a great convenience, and economy in space, labor, and material.

Cloth.—Finding the grass mats of Europe too expensive for use in California, various experiments were made in order to test the kind of cloth best suited to the conditions. In Southern California, and elsewhere, "Turkish crash" has been found to be well adapted as a substitute for mats. It was impossible to get this in time, so various grades of coarse "duck," linen "huck," and sail-cloth were tried. The linen "huck" was an unqualified failure; the "duck" was better, but not

practical, while the sail-cloth worked admirably. The cost of sail-cloth sufficient to envelop twenty-five pounds of pulp is about 50 cents. The cost of a mat that holds the same quantity is from $1 50 to $2.

The "Separator."

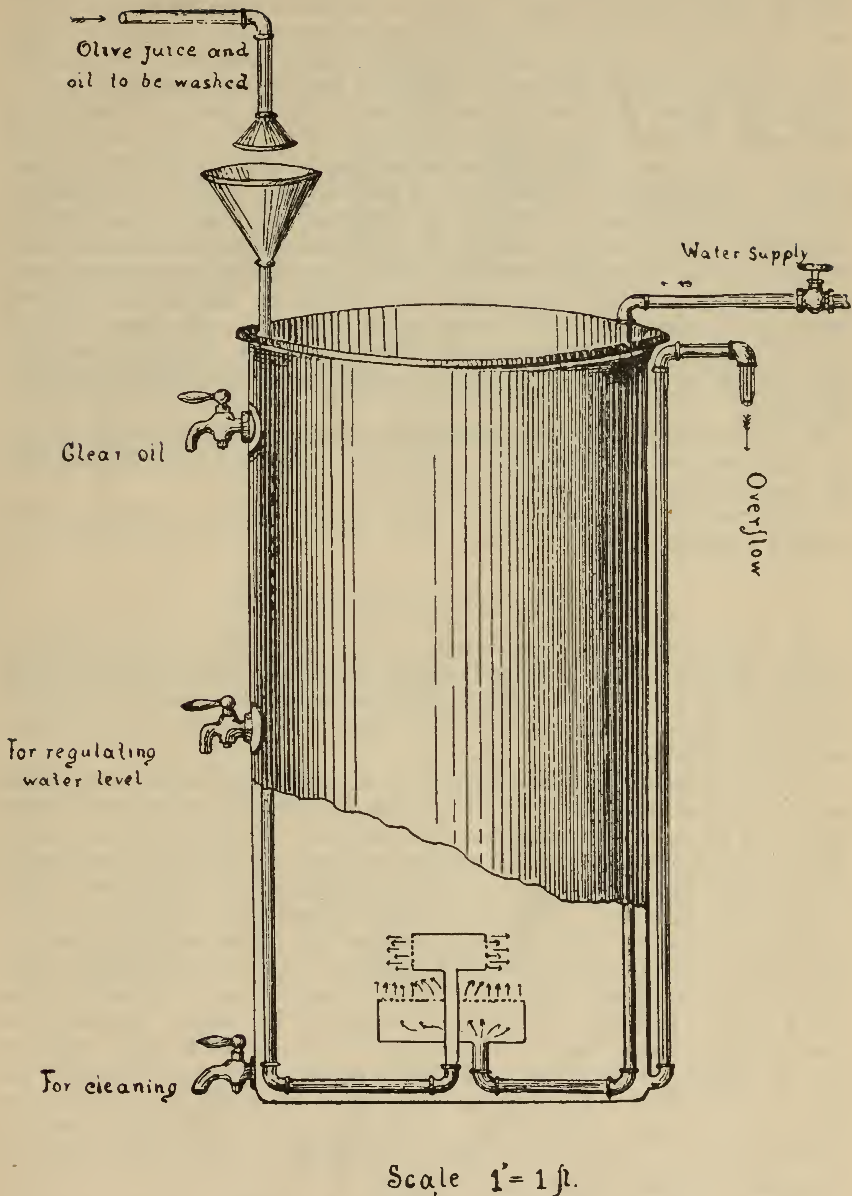
One of the troublesome processes in the making of olive oil is the separation of the oil from the watery juice after it comes from the oil press. The universal custom is to collect this mixture of water and oil as it drips from the press, and leave it several hours; then to skim off the oil that has risen to the top by reason of its lightness. This skimming must be repeated every few hours, till the oil is entirely separated; for, if not at once removed it acquires a bad taste, from the fermentable juices, which are heavily charged with broken tissues, etc. Besides the necessary hand work, it requires a large room, and a very expensive outfit of large tanks. In order to avoid all this expense and trouble, an apparatus was made that performs the work automatically and continuously, enabling the oil maker to have pure, clean oil within two minutes from the time it leaves the press.

Its construction and working was seen by the writer in the oil-room of Prof. E. Mingioli, of the Royal Agricultural School at Portici, near Naples, Italy. The apparatus as shown in the plate consists essentially of a tin tank, about four feet high by two in diameter. This tank is kept constantly full of fresh water by means of a pipe connected with some adequate supply, the level being regulated by means of stop-cock outlets. The juices from the pressing, charged with oil in a finely emulsified state, are made to flow into the tank near the bottom, through a small "drum," perforated laterally. Immediately below this oil-escape is a larger flat "drum," perforated on the top, from which a stream of fresh water escapes in vertical jets. These two currents of oil and fresh water at once mix, and the oil passes upwards, by reason of its lightness. Being in very small drops, it is washed of its heavier impurities (tissue, coloring matter, etc.), and reaches the top of the column of water in an almost perfectly clean state, having left all grosser impurities to be carried off through an escape pipe at the bottom. When sufficient oil has been collected at the top, a stop-cock is opened and the oil runs off ready to be clarified. The level once established, the apparatus will work uninterruptedly for a long time without being cleaned out. Though the small quantities of olives at the disposal of the Station did not permit of any long continued test of the process, yet it was found that the larger the quantities used, the better the separator worked. No doubt it is susceptible of many small improvements, such as automatic regulators, etc.; still, on the whole, it was found to work very well indeed, and to be a vast improvement on the method of hand skimming.

A model of this "separator," together with oil made at the Station, and olives, olive pits, etc., can now be seen in the agricultural alcove of the University exhibit at the Midwinter Fair.

CLARIFICATION OF THE OIL.

The American market requires that olive oil should be put in glass, and be perfectly clear and brilliant. This necessitates careful filtration. Strictly speaking, olive oil should not be filtered at all, for by the pro-



OLIVE OIL SEPARATOR.
Designed by Prof. Mingioli, Italy.

cess of filtration it loses a great deal of its characteristic taste and odor. Highly clarified oil is prettier to look at, but is not as agreeable to the taste as that which has been allowed to deposit naturally its solid matter. The oftener an oil is filtered, the more neutral in taste it becomes. In Europe, oil is seldom clarified so highly as in America. There, simple cotton-batting is used for oil intended for domestic purposes, but in California, where only the most brilliant oil is in demand, something less porous than cotton-batting is required.

In the oil-room of the Station, experiments were made with cotton-batting, "glass wool," asbestos, and filter-paper. All but good filter-paper, such as is used in chemical laboratories, was found to be unfit for purposes of clarification. Even with good filter-paper, some varieties of oil were found to require two filtrations before becoming perfectly clear and brilliant. It was also noted that where oil was at once filtered after separation, there was a tendency to become cloudy after a month or so in the bottle. Hence, in the clarification of oil, care should be taken to use only paper of such good quality as will necessitate but one filtration.

It was found that it was impossible to filter olive oil in a room where the temperature was below 45°. Of course no heat should be used, but the temperature should be at least 50° F.

The absolute avoidance of all odors in the oil-room cannot be too stongly insisted upon.

ANALYSES OF OLIVES AND OLIVE OIL.

The twenty-four analyses made in the laboratory of the Central Station during the two previous seasons have been tabulated with those of the season of 1893–94, thus giving more extended data for comparison of the value of varieties, and their relative adaptation in the various parts of the State.

It will be noted that the tables do not contain the iodine absorptions as in previous years; also that a column showing the number of olives necessary to make 100 grams has been added. The reason for this insertion is that the reader may be enabled to form a pretty accurate idea of the relative size of the fruit without troublesome cross references. This tabulation, taken with Column 1, which shows the proportion of pits and flesh found in the fresh fruit, enables the reader to determine at a glance the value of any variety for pickling. Take, for example, Polymorpha and Redding Picholine. In one case it takes 13 olives to make 100 grams, in the other it takes an average of 79 olives. Moreover, in the 13 Polymorphas there is 17 per cent of pit and 83 of flesh, while in the 79 Redding Picholines there is an average of 24.41 per cent of pit and 75.58 of flesh. Keeping in mind that for pickles the object is to have an olive that, while being as large as possible, has the smallest possible pit, one has little trouble in judging of the relative merit of whatever varieties he may have in mind.

Column 2 shows the percentage of oil it is possible to extract from the whole fruit by the most careful chemical processes. It shows also the uselessness of taking into consideration the oil contained in the pits. Even were this pit-oil available and unobjectionable, the actual quantity would not pay for the trouble of extraction; but such very small

quantities disseminated throughout a mass of hard material, renders their expression by mechanical means a problem of no practical interest.

But aside from the uselessness of attempting to extract the pit-oil, the kernel imparts a disagreeable taste to the oil of the flesh with which it comes in contact, and impairs its keeping qualities.

It is Column 3 that serves chiefly for the study of the values of olive varieties. In the second row of Column 1 we find the percentage of flesh in the whole fruit; in the second half of Column 3 we find what part of this flesh is oil, and what part refuse matter.

Table II is a comparative table of averages of those varieties of which two or more samples were received at the Station. It is to be regretted that the tables are so incomplete; but it was too late in the season to make proper arrangements to obtain more samples when the work was assigned to the new assistant.

It is hoped that next year olive growers from all parts of the State will send samples of the varieties they may have to the Agricultural Experiment Station in Berkeley, in order that this study may be made as complete as possible. It is only with the coöperation of the olive growers that the problem of adaptation of varieties to soil and climate can be solved.

TABLE I. PARTIAL ANALYSES OF SOME SAMPLES OF CALIFORNIA OLIVES AND OILS. (CROPS OF 1890–94.)

Number	Variety.	Locality.	Date of Picking.	No. of Olives in 100 grams	1 Proportion of Pits and Flesh in Fruits.		2 Percentage of Oil in Whole Fruit possibly yielded by		3 Percentage of Oil contained in Fresh	
					Pits.	Flesh.	Pits.	Flesh.	Pits.	Flesh.
1	Manzanillo	Fresno	Nov. 4, 1890		13.00	87.00	.53	19.23	4.10	22.01
2	Manzanillo	Berkeley	Jan. 20, 1891		16.00	84.00	.51	21.38	3.20	25.45
27	Manzanillo	Pomona	Nov. 13, 1890	16	22.50	77.50	.66	15.10	3.00	20.00
40	Manzanillo	Mission San José	Dec. 5, 1893	32	17.00	83.00		20.84		25.10
86	Manzanillo	Pomona	Dec. 26, 1893	15	12.00	88.00	.50	19.60	4.23	22.30
	Average			21	16.10	83.90	.55	19.23	3.84	22.57
6	Nevadillo Blanco	Fresno	Nov. 4, 1890		17.50	82.50	1.60	18.02	6.60	22.00
7	Nevadillo Blanco	Mission San José	Jan. 7, 1891		24.00	76.00	1.06	23.94	4.40	31.50
8	Nevadillo Blanco	Berkeley	Jan. 7, 1891		25.00	75.00	1.05	22.72	4.20	30.30
17	Nevadillo Blanco	Mission San José	Dec. 16, 1891		20.50	79.50	.94	25.65	4.70	32.06
33	Nevadillo Blanco	Pomona	Nov. 22, 1893	28	15.00	85.00		19.30		22.72
39	Nevadillo Blanco	Mission San José	Dec. 5, 1893	70	25.00	75.00		15.35		20.50
58	Nevadillo Blanco	Biggs	Dec. 11, 1893	30	18.00	82.00		16.22		19.00
64	Nevadillo Blanco	Chico	Dec. 21, 1893	19	18.00	82.00		18.98		23.15
82	Nevadillo Blanco	Pomona	Dec. 26, 1893	29	17.00	83.00	.75	18.50	4.44	22.30
	Average			35	20.55	80.00	1.08	19.85	4.86	24.83
12	Mission	Mission San José	Jan. 8, 1891		23.50	76.50	.94	19.07	4.00	24.90
23	Mission	Newcastle	Mar. 9, 1891		20.00	80.00	.61	16.55	3.07	20.68
24	Mission	Mission San José	Dec. 16, 1891		16.50	83.50	.40	18.72	2.40	21.40
25	Mission	Fresno	Jan. 12, 1892		18.00	82.00	.70	23.08	3.70	28.15
26	Mission	Newcastle	Jan. 14, 1892		17.50	82.50	.50	17.50	3.20	21.31
42	Mission	Mission San José	Dec. 5, 1893	47	25.00	75.00		16.45		21.90
43	Mission	Mission San José	Dec. 5, 1893	42	26.00	74.00		15.31		20.00
53	Mission	Biggs	Dec. 11, 1893	26	17.00	83.00		17.78		21.40
62	Mission	Livermore	Dec. 15, 1893	34	25.00	75.00		22.73		30.29
63	Mission	Chico	Dec. 21, 1893	17	15.00	85.00		20.75		24.40
71	Mission	El Quito	Dec. 22, 1893	34	22.00	78.00		15.01		19.20
79	Mission	Pomona	Dec. 26, 1893	20	15.00	85.00	.52	19.46	3.50	22.90
87	Mission	St. Helena	Dec. 28, 1893	22	15.00	85.00		18.70		22.00
	Average			30.25	19.60	80.00	.61	18.77	3.44	22.94

13	Rubra	Fresno	Feb. 5, 1891		19.50	80.50	.80	17.69	4.10	21.97
14	Rubra	Fresno	Jan. 12, 1892		15.00	85.00	.80	20.00	5.20	23.53
15	Rubra	Newcastle	Jan. 14, 1892		21.00	79.00	.80	27.57	4.00	34.90
32	Rubra	Pomona	Nov. 19, 1893	35	18.00	82.00		17.88		21.57
35	Rubra	Niles	Dec. 7, 1893	38	20.00	80.00		11.88		14.85
46	Rubra	Biggs	Dec. 11, 1893	42	17.00	83.00		15.24		18.40
72	Rubra (?)	Biggs	Dec. 23, 1893	42	18.00	82.00		18.40		22.40
73	Rubra	Biggs	Dec. 23, 1893	47	16.00	84.00		14.85		17.70
83	Rubra	Pomona	Dec. 26, 1893	41	16.00	84.00	.91	21.44	5.70	25.53
	Average			40.83	17.80	79.94	.82	18.33	4.75	22.28
5	Atro-violacea	Fresno	Nov. 4, 1890		23.70	76.30	1.19	13.78	5.00	18.10
16	Atro-violacea	Newcastle	Jan. 14, 1892		16.00	84.00	.73	21.90	4.40	26.70
37	Atro-violacea	Mission San José	Dec. 5, 1893	48	25.00	75.00		20.83		27.80
55	Atro-violacea	Biggs	Dec. 11, 1893	41	20.00	80.00		13.74		17.17
75	Atro-violacea	Biggs	Dec. 23, 1893	48	25.00	75.00		14.69		19.58
	Average			45	21.94	78.00	.96	16.98	4.70	21.87
11	Redding Picholine	Mission San José	Jan. 8, 1891		29.00	71.00	1.88	21.87	6.50	30.80
18	Redding Picholine	Mission San José	Dec. 16, 1891		24.50	75.50	1.17	22.99	4.70	30.70
34	Redding Picholine	Auburn	Nov. 27, 1893	78	21.00	79.00		17.08		21.60
52	Redding Picholine	Biggs	Dec. 11, 1893	91	25.00	75.00		13.27		17.70
60	Redding Picholine	Livermore	Dec. 15, 1893	67	23.00	77.00		20.80		27.00
65	Redding Picholine	Chico	Dec. 21, 1893	80	24.00	76.00		15.25		20.10
	Average			79	24.41	75.58	1.52	18.64	5.60	24.65
20	Oblonga	Fresno	Jan. 12, 1892		18.00	82.00	.90	14.95	4.60	18.23
41	Oblonga	Mission San José	Dec. 5, 1893	40	25.00	75.00		15.10		20.10
47	Oblonga	Biggs	Dec. 11, 1893	25	15.00	85.00		10.85		12.80
61	Oblonga	Livermore	Dec. 15, 1893	37	21.00	79.00		20.50		26.00
92	Oblonga	Berkeley	Jan. 4, 1894	67	20.00	80.00		9.29		11.61
76	Oblonga	Biggs	Dec. 23, 1893	34	17.00	83.00		11.10		13.40
	Average			40.60	19.00	80.66	.90	13.63	4.60	17.02
22	Columbella	Fresno	Jan. 12, 1892		17.00	83.00	.50	15.20	3.10	18.35
45	Columbella	Mission San José	Dec. 15, 1893	49	25.00	75.00		16.32		21.80
56	Columbella	Biggs	Dec. 11, 1893	28	15.00	85.00	.63	13.53	4.20	16.00
80	Columbella	Pomona	Dec. 26, 1893	19	15.00	85.00	.68	17.39	4.62	20.05
91	Columbella	Berkeley	Jan. 4, 1894	70	20.00	80.00		14.13		17.65
	Average			41.50	18.40	81.60	.60	15.31	3.93	18.77
3	Pendulina	Fresno	Nov. 4, 1890		14.80	85.20	1.04	17.40	7.00	20.50
84	Pendulina	Pomona	Dec. 26, 1893	29	13.00	87.00	.92	18.81	7.10	21.70
77	Pendulina	Biggs	Dec. 23, 1893	13	15.00	85.00		10.00		11.70
	Average			21	14.26	85.66	.98	15.40	7.05	21.30

PARTIAL ANALYSES OF SOME SAMPLES OF CALIFORNIA OLIVES AND OILS. (CROPS OF 1890–94.)—Continued.

Number	Variety.	Locality.	Date of Picking.	No. of Olives in 100 grams	1 Proportion of Pits and Flesh in Fruits.		2 Percentage of Oil in Whole Fruit possibly yielded by		3 Percentage of Oil contained in Fresh	
					Pits.	Flesh.	Pits.	Flesh.	Pits.	Flesh.
21	Præcox	Fresno	Jan. 12, 1892		17.00	83.00	.60	12.87	3.09	15.40
54	Præcox	Biggs	Dec. 11, 1893	48	19.00	81.00	1.10	16.86	6.06	20.00
93	Præcox	Berkeley	Jan. 4, 1894	71	20.00	80.00	.72	10.67	3.60	13.35
	Average			59.50	18.00	81.00	.80	13.48	4.50	16.51
57	Uvaria	Biggs	Dec. 11, 1893	39	25.00	75.00		11.00		14.66
74	Uvaria	Biggs	Dec. 23, 1893	44	27.00	73.00		9.64		13.20
81	Uvaria	Pomona	Dec. 26, 1893	33	22.00	78.00	1.05	11.38	4.76	17.40
	Average			38.30	24.66	75.36		11.38		15.08
19	Atro-rubens	Fresno	Jan. 12, 1892		18.50	81.50	.80	21.26	4.20	26.10
49	Atro-rubens	Biggs	Dec. 11, 1893	28	15.00	85.00	.71	16.68	4.11	19.60
	Average				16.75	83.25	.75	18.97	4.15	22.85
50	Nigerina	Biggs	Dec. 11, 1893	36	15.00	85.00	.94	18.16	6.24	21.31
85	Nigerina	Pomona	Dec. 26, 1893	23	15.00	85.00	.53	22.35	3.46	26.30
	Average			29	15.00	85.00	.73	20.25	4.85	23.85
59	Columbaro	Biggs	Dec. 14, 1893	23	15.00	85.00	.50	17.73	3.38	20.85
78	Polymorpha	Biggs	Dec. 23, 1893	13	17.00	83.00	.66	13.65	3.90	16.40
88	Lucques	Livermore	Dec. 28, 1893	67	30.00	70.00	1.00	13.06	3.32	18.70
89	Piangente	Berkeley	Jan. 4, 1894	76	22.00	78.00	.86	13.48	3.92	17.30
90	Hervaza	Berkeley	Jan. 4, 1894	21	17.00	83.00	.37	12.98	2.20	15.60
36	Rock's No. 57	Niles	Dec. 7, 1893	65	21.00	79.00		7.12		9.30
9	Seedling, No. 10	Berkeley	Jan. 4, 1894	77	25.00	75.00		13.90		18.53
48	Amellau	Biggs	Dec. 11, 1893	19	16.00	84.00	.48	14.00	3.02	17.50

38	No. 16, Row E	Mission San José	Dec. 8, 1893	79	32.00	68.00	----------	19.00	----------	28.00
67	Razzo	El Quito	Dec. 22, 1893	52	20.00	70.00	1.08	23.59	3.65	33.70
70	Grossajo	El Quito	Dec. 22, 1893	53	28.00	72.00	1.03	25.03	3.72	34.76
68	Correggiolo	El Quito	Dec. 22, 1893	53	33.00	70.00	1.20	20.29	4.07	28.98
66	Frantojo	El Quito	Dec. 22, 1893	74	30.00	70.00	1.00	18.69	3.36	26.70
69	Morajolo	El Quito	Dec. 22, 1893	55	33.00	67.00	1.45	21.93	4.43	32.72
44	Regalis	Mission San José	Dec. 5, 1893	34	22.00	78.00	1.19	16.85	5.47	21.60
51	Becca Rufa	Biggs	Dec. 11, 1893	58	19.00	81.00	1.10	21.05	6.00	25.29

TABLE II. AVERAGES BY OLIVE VARIETIES, WITH MAXIMUM AND MINIMUM.

Variety.	Number of Samples Examined	Percentage of Oil in Fresh Fruit.				Number of Olives in 100 grams.			Percentage of Flesh in Whole Fruit.			Percentage of Pit in Whole Fruit.		
		Maximum	Minimum	Average	Variation	Maximum	Minimum	Average	Maximum	Minimum	Average	Maximum	Minimum	Average
Rubra	9	34.70	14.85	22.28	20.05	47	35	40	85	79	79	21	15	19.60
Nevadillo Blanco	9	32.06	19.00	24.83	13.06	70	19	35	85	75	80	25	15	20.00
Mission	13	30.29	19.20	22.94	11.09	47	17	30	85	74	80	26	15	19.00
Redding Picholine	6	30.80	17.70	24.00	13.10	91	67	79	79	71	75	29	21	24.00
Atro-rubens	2	26.10	19.60	22.85	6.50	28	28	28	85	81	83	18	15	16.00
Oblonga	5	26.00	11.61	17.02	14.21	67	25	40	85	75	80	25	15	19.00
Nigerina	2	26.30	21.31	23.85	5.00	36	23	29	85	85	85	15	15	15.00
Manzanillo	5	25.45	20.00	22.30	5.10	32	15	21	88	77	83	22	12	16.00
Pendulina	3	21.50	11.70	21.30	10.00	29	13	21	87	85	85	15	13	14.00
Præcox	3	20.80	13.35	16.51	7.45	71	48	59	83	80	81	20	17	18.00
Uvaria	3	17.40	13.20	15.08	4.20	44	33	38	78	73	75	27	22	24.00

Examination of Table I brings out the importance of a close study of soil, climate, and varieties before undertaking to plant an olive orchard. It will be seen that there are varieties that yield a very high percentage of oil, and others that do not. Further, it appears that the same variety, on different soils, etc., will vary 20 per cent in the amount of oil yielded, while the crop on each may, to all appearances, be equally heavy. Thus the Rubra, in one place, contains as much as 34.90 per cent of oil, and in another locality has but 14.85 per cent—a difference sufficient to ruin an olive grower in a few years. This variation in oil yield is most easily studied in Table II, in which the maximum, minimum, and averages have been conveniently arranged.

It will be noticed (Table II) that in the eleven varieties of which more than two samples were received, the differences between the maximum and minimum of oil in fresh fruit varies very greatly: thus, while in the Rubra the difference is 20.05, in the Uvaria it is only 4.20—thus showing for the latter a greater uniformity in oil percentages for the State at large. The following list comprises the commonest varieties now growing in California, and the table is arranged in the order of highest to lowest variations between maximum and minimum oil percentage:

Variety.	Variation.
Rubra	20.05
Oblonga	14.21
Redding Picholine	13.10
Nevadillo Blanco	13.06
Mission	11.09
Pendulina	10.00
Præcox	7.45
Atro-rubens	6.50
Manzanillo	5.10
Nigerina	5.00
Uvaria	4.20

The table shows what a matter of "guess work" the selection of varieties for orchards in the State has been thus far, and emphasizes the importance of the work undertaken by the Agricultural Experiment Station in bringing out all of these various characteristics.

It would not be safe to pass judgment too hastily, taking into consideration the relatively small number of analyses at our command, yet it will at once be seen that there are varieties that seem to be better adapted, for general planting, than others. Take, for example, the Mission. This is the oldest variety cultivated in California, and we have examined thirteen samples; yet it stands as a very good oil variety, never falling below 19.20 per cent of oil, and an average of 30 olives in 100 grams (144 in one pound). This fact, taken with the experiments in the oil-room, show it to be one of the preëminently safe varieties to plant. It gives an oil of very good quality, and one that keeps its marketable qualities in an exceptionally good manner.

What is said of the Mission can be said of the Manzanillo, which, while being a trifle larger than the Mission, is a more regular bearer, and fully as hardy.

The Nevadillo Blanco, while a smaller olive than either of the other two, is, by reason of its high average in oil, and its regularity as a bearer, one of the olives of the future.

The Redding Picholine shows itself unworthy of the place it has in the olive plantations of the State. Though it is a good bearer, and a vigorous grower, it is the smallest olive of any of the varieties thus far found in California. It has more pit and less flesh than any other variety. Next to the Rubra it varies more than any other in the above table, and the oil-room experiments show it to give an inferior product. Of all the oils made this year in the Station oil-room, that of the Redding Picholine was the "greasiest" and the first to solidify, assuming the appearance of partly melted, yellowish lard.

The Uvaria was a disappointment, the general impression being that it was a very good oil variety, so far as regards quantity.

The Rubra, in spite of its uncertainty as to richness in oil, is a good variety when well adapted to its surroundings. The Rubra oil made at the Station was of a very high degree of excellence, and stood cold weather very well.

For the first time we have analyses of the leading Italian varieties, *i. e.*, Grossajo, Razzo, Frantojo, Correggiolo, and Morajolo. From the very high yield of oil, when we take into account that the Mission on the same soil gives but 19.20 per cent of oil, we are led to conclude that these new varieties will be of great importance in the future.

Further comment is not deemed wise at this time, owing to the fact that there are too few varieties of which samples were received from more than one locality. In another year, with the coöperation of the olive growers of the State, it will be possible to discuss more fully the results. They are given to the public as they stand, as the only data existing at this moment.

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